DOCUMENT RESUME

ED 330 718 TM 016 306

AUTHOR	Walls, Richard T.; And Others
TITLE	Fan Size and Foil Type in Recognition Memory.
SPONS AGENCY	National Inst. on Disability and Rehabilitation Research (ED/OSERS), Washington, DC.
PUB DATE	87
NOTE	31p.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*College Students; Computer Assisted Testing; Dialogs (Language); *Distractors (Tests); Higher Education; *Recognition (Psychology); Redundancy; Semantics; Timed Tests
IDENTIFIERS	Episodic Memory; *Fan Spread Hypothesis; *Retrieval (Memory); Story Content; West Virginia University

ABSTRACT

An experiment involving 20 graduate and undergraduate students (7 males and 13 females) at West Virginia University (Morgantown) assessed "fan network structures" of recognition memory. A fan in network memory structure occurs when several facts are connected into a single node (concept). The more links from that concept to various discrete facts (the larger the fan), the slower the retrieval time (fan effect). The experimental design of this study, which used a fact retrieval paradigm, was a three-way, mixed design with one between-subjects independent variable (the number of times a conversation was heard by a learner) and two within-subjects independent variables (fan size and type of test statement). Subjects listened either one time or three times to a 2.5-minute conversation between Sherlock Holmes and Doctor Watson that was taped from a radio program. The subjects were tested, using a timing program, for recognition of target probes and three types of foils (within-fan, cross-fan, and outside-story) associated with large versus small fans. Twenty-four test statements were administered. Fan size, type of test statement (target probes and foils or distractors), and number of times heard all had significant effects on recognition memory. There was also evidence that semantic and episodic themes were operating to influence performance. The text of the conversation used in the study is included. A 20-item list of references and three data tables are provided. (TJH)

Fan Size and Foil Type in Recognition Memory

Richard T. Walls

Elizabeth A. McGreal

Lois E. Bennett

Denetta L. Dowler

West Virginia University

Running Head: Fan Size and Foil Type

Abstract

A fan in network memory structure occurs when several facts are connected to a single node (concept). The more links from that concept to various discrete facts (the larger the fan), the slower the retrieval time (fan effect). Subjects in this research heard a conversation between Sherlock Holmes and Dr. Watson either one time or three times. They were tested, using a timing program, for recognition of target prcbes and three types of foils (within-fan, cross-fan, and outside-story) associated with large versus small fans. Fan size, type of test statement (target probes and foils), and number of times heard all had significant effects on recognition memory. There was evidence that semantic and episodic themes were cperating to influence performance.

Fan Size and Foil Type in Recognition Memory

Several studies in the 1970s demonstrated that the more facts a person has associated with a concept, the longer it will take to retrieve any one of those facts. This phenomenon is called the "fan effect" (Anderson, 1983a; King & Anderson, 1976). A fan is said to be formed when several facts are connected to a single node (concept). A fan of size two has two facts associated with a single concept. For example, the artist (a) "was in the corner saloon" and (b) "had a ticket for the Red Sox game." Thus, facts a and b are attached to a single concept (artist). A fan of size six would have six facts associated with a single concept. When a node is activated during memory search, the activation is said to spread along all links to other nodes that fan out from the activated node. The amount of activation that spreads is divided among all links in the fan. Thus, the more links (the larger the fan), the less activation strength available for each link (Anderson & Bower, 1973; King & Anderson, 1976).

The findings from the early fan-effect research indicated that reaction time increases systematically as the size of the fan increases. That conclusion would say that the more you know about a topic, the more difficult it is to retrieve a specific fact. Smith, Adams, and Schorr (1978) commented, "If

facts about the same concept can interfere with one another, then the more facts learned about a concept the greater the potential interference. Thus, as one becomes increasingly knowledgeable about a topic, one should experience increasing difficulty in answering questions about it. But this runs counter to intuitions, for it often seems that an increase in our knowledge leads to an increase in both the number of questions we can answer about a topic and the speed with which we do so" (pp. 438-439).

The classic fan effect can be reduced, eliminated, or even reversed. Fan effects can be reduced through (a) increased practice during learning (Hayes-Roth, 1977; Pirolli & Anderson, 1985), (b) thematic association of facts (Moeser, 1979; Smith, Adams, & Schorr, 1978), and (c) integration of facts through causal linkage. Two seemingly unrelated statements like "Marty broke the bottle" and "Marty did not delay the trip" can be organized into a single theme when presented with a third statement such as "Marty was chosen to christen the ship." This thematic relationship among concepts reduces the fan effect for facts within any one theme, although it has been shown that multiple themes can create a theme fan effect of their own (Reder & Anderson, 1980; Reder & Ross, 1983). Further, the fan effect can be eliminated or reversed by using facts that are causally linked to form an integrated network (Myers, O'Brien, Balota, & Toyofuku, 1984). For instance, a predicate like "sat down as the umpired yelled play ball" would be followed in a sequential script by one

such as "saw the start of the ball game." As the level of integration or causal linkage increases, the fan effect becomes smaller. Using a high-integration condition, Myers et al. (1984) obtained a negative (reversed) fan effect for recognition time. That is, faster response times were associated with the greater fan.

During the testing phase of an experiment on fan effects, it is typical to present target probes (statements that the learner has seen or studied) balanced with an equal number of foils (distractor statements). Foils are generally constructed by recombining the subjects and predicates from studied facts or combining studied subjects with novel predicates. For example, if the learner had studied "The lawyer was in the bank" and "The teacher was in the park," foils might be "The lawyer was in the park" and "The teacher was in the church."

In general, false statements (foils) tend to be rejected more slowly than true statements (target probes) are accepted (Reder & Anderson, 1983). As in the classic fan effect, foils may be rejected more slowly when more discrete facts have been learned about a subject and where an exhaustive search is required to reject them (Peterson & Potts, 1982; Reder & Ross, 1983). In contrast, when a temporal-spatial episode or a semantic theme has been established, the fan effect may be neutralized. Moeser (1979) spoke of "integrated storage" in which interrelated sentences were stored as one unit of information. Integrated storage is also facilitated by

presenting the related sentences as a block during the encoding process rather than randomly interspersing them with sentences from other scripts or themes.

If a foil has a predicate that the learner has never encountered, or if a predicate has high salience as being inconsistent with the learned facts, response time and the fan effect should be decreased. For example, in the present research, a statement such as, "Sherlock Holmes wore pink sunglasses" should be quickly and accurately rejected. Even when the foil has a plausible predicate that the learner never encountered, response time should be short. For example, "Sherlock Holmes wore a brown vest" might take longer to reject than pink sunglasses since it is consistent with the tenor of the studied material, but rejection should still be fairly rapid. This might be similar to the "quick don't know" that has been demonstrated by Glucksberg and McCloskey (1981) for an item such as, "What is the biggest department store in Budapest?"

Three types of foils were used in the present research. The "brown vest" example would be a false-outside-the-story foil since the brown vest was never mentioned. A false-inside-the-fan foil would pair the target subject with a distorted predicate. A third type of foil, false-cross-fan, would re-pair the target subject with a predicate from another fan. These latter two types of foils (within-fan and cross-fan) should be more difficult for learners than when the target subject was paired with a totally novel predicate.

Interference effects increase when both parts of a foil have been previously presented (Osgood, 1949). Cross-fan foils may be particularly time consuming to process because of the necessity to search more than one fan and to cross from one fan to another in the network memory structure. The type of foil should, thus, differentially affect performance.

Response time and accuracy should also be affected by the level of familiarity with the message. As Hayes-Roth (1977) and Pirolli and Anderson (1985) demonstrated, fan interference can be eliminated by extra practice during the acquisition-encoding phase. In the present experiment, learners heard a conversation between Sherlock Holmes and Dr. Watson. Hearing the discussion multiple times should promote overlearning and reduce interference effects by making true statements and foils more easily recognizable. Multiple exposures should increase node (concept) strength and consequent link strength between concepts (Anderson, 1983b). The exchange between Holmes and Watson focused on two major characters involved in a mystery story. Both of these characters had several facts associated with them (large fan). In addition, other topics with fewer associated facts (small fan) were described by Watson and Holmes. Performance may not necessarily be affected by fan size since the thematic and episodic nature of the conversation should allow strong integration.

Fewest errors and fastest performance should, thus, be associated with verification of true statements. In addition,

foils as well as true statements should be quickly and accurately processed when overlearning (multiple exposures) of the message is involved. Slowest verification may occur with false statements that involve cross-fan interference. Traditionally, stimulus materials for this type of interference research, even episodic script research, have been artificially constructed (e.g., Anderson, 1974; Myers et al., 1984). The conversation used herein allowed testing of various sizes of fans and types of foils in a more real-world communication context.

Method

Subjects

The subjects (learners) were 20 graduate and undergraduate students at West Virginia University. There were 7 males and 13 females enrolled in a variety of majors. Participation was voluntary, and no academic credit was earned. Subjects (learners) received $5 at the time they signed the consent form. Procedures for confidentiality as well as selection and treatment of learners followed APA and WVU guidelines.

Design

The experimental design of this fact retrieval paradigm was a three-way, mixed design with one between-subjects independent variable and two within-subjects independent variables. The between-subjects variable was the number of

times the conversation was heard by the learner. The learners were randomly assigned to hear the conversation one time (n = 10) versus three times (n = 10).

A within-subjects variable was fan size. For this variable, test statements were drawn from large fans (single nodes with more than ten facts related to them) versus small fans (single nodes with five or fewer facts associated with them). One large fan consisted of the 11 facts associated with Miss Helen Stoner (e.g., would call at eleven; was a charming girl; was afraid of stepfather). The other large fan included the 13 facts associated with Grimsby Roylott (e.g., was a dreadful fellow; married money; is a widower). The small fans centered around the concepts of the old house (2 facts), the wife (2 facts), the trust fund (2 facts), the letter (4 facts), the witnesses (3 facts), and the scrapbook (5 facts). Each learner attempted to verify 12 statements from large fans and 12 statements from small fans.

A second within-subjects variable was type of test statement, which included four conditions. Statements were either (a) target probes (true), (b) within-fan foils (false), (c) outside-story foils (false), or (d) cross-fan foils (false). Target probes tested true relationships within fans: The old house (subject) was in Stokemoran (predicate). Within-fan foils paired a subject with a distorted predicate from the same fan: Miss Helen Stoner (subject) wrote to Watson (predicate). She really had written to Holmes. Outside-story foils paired a subject in the conversation with

a predicate that was never mentioned: The scrapbook (subject) was on Watson's desk (predicate). Cross-fan foils paired a subject from one fan with a predicate from a different fan: Dr. Grimsby Roylott (subject) had a sister who died suddenly (predicate). Each learner attempted to verify 12 target probes and 12 foils. The false statements included (a) 4 within-fan foils, (b) 4 outside-story foils, and (c) 4 cross-fan foils. It was necessary to use 12 true statements to balance the total number of 12 false statements.

The dependent measures were (a) response time in milliseconds and (b) number of correct responses per condition. In the analyses, the number of possible responses per condition was taken into account to provide for fair comparisons among conditions.

Materials

The story (conversation) was a two and one-half minute segment from a taped radio show entitled "The Adventure of the Speckled Band." The tape was a reproduction of a Sherlock Holmes drama that aired in 1945 (Murray Hill Records, Mutual Broadcasting System, 1945). It is a conversation between Holmes and Watson about Miss Helen Stoner's fear of her stepfather Grimsby Roylott. In the segment, Holmes and Watson discuss the facts of the Stoner case. The text of the segment used in this experiment is reproduced in Appendix A.

The 24 test statements involved concepts from the conversation. These statements are shown in Table 1. Not

every fact from the conversation was tested, and no probes were direct quotes.

Insert Table 1 about here.

A computer program was written in BASIC to randomly present the test statements and record response times. An IBM portable computer was used during testing sessions. The program uses clock time rather than machine time to record the learner's response. The N key on the keyboard was marked F for false, and the B key was marked T for true.

Procedure

The learners were tested individually. The nature and purpose of the experiment were explained, and learners were given orientation to the testing procedure. During this orientation phase, learners responded to four training statements, e.g., "M & M candies come in assorted colors." They pressed the T or F response key after the statement appeared on the microcomputer screen.

A recorded message then instructed the learner to listen carefully to the conversation between Sherlock Holmes and Dr. Watson. They were told they would be responding to statements from the segment. Depending on the experimental condition, learners heard the conversation either one or three times. Those who listened to it three times heard a one-sentence reminder of the instructions before each

repetition of the taped conversation.

Once learners had heard the tape, they silently read the testing instructions on the computer screen as the experimenter read them aloud. "Statements about the conversation you just heard are coming up now. Press the TRUE key if the statement on the screen is true or the FALSE key if the statement is false. Answer as quickly as possible, but also be as accurate as you can. If you are not sure, make the best guess possible."

The 24 test statements appeared in a different random order on the screen for each learner. An arrow alerted the learner prior to each statement and remained on the screen for two seconds to indicate the spot where the statement would appear. Each test statement was split so that the subject (e.g., Miss Helen Stoner) appeared immediately to the right of the arrow, and the predicate (e.g., wrote to Watson) was printed directly below the subject. Timing began as soon as the complete statement appeared on the screen. The statement remained on the screen until the learner pressed the T or F key. This response stopped the timer. The screen remained blank for two seconds before the arrow signaled the next test statement. All learners responded to all 24 statements.

Results

The analyses were organized to describe the effects of (a) the number of times the message was heard, (b) fan size, and (c) type of test statement. A 2 X 2 X 4 mixed analysis of

variance was computed for number of times heard (one versus three) by fan size (small versus large) by type of statement (true, false within-fan, false outside-story, false cross-fan). The dependent measure in this first analysis was response time. Since it is important to test learners' memory structures rather than guessing, only correct responses were used in this analysis. In addition, the item in each condition having the highest proportion of correct responses across all learners was used in the analysis. That is, eight items (2 fan sizes by 4 types of test statements) were used since they were responded to correctly, on the average, on 84% of the attempts.

Insert Table 2 and Table 3 about here.

This 2 X 2 X 4 analysis of variance yielded a significant two-way interaction for number of times heard by type of test statement, F (2, 52) = 2.68, $p < .05$. Means for this interaction are reported in Table 2. Follow-up tests by the Duncan Multiple-Range Test revealed significantly (all at least $p < .05$) more time taken to process cross-fan foils than target probes (true) or within-fan foils when learners heard the conversation only once. Hearing the message three times, however, had a leveling effect and eliminated those differences. Times were generally faster when the message was heard three times, and the cross-fan foil was significantly faster than when heard one time.

The analysis of variance also revealed a second two-way interaction, fan size by type of test statement, F (3, 30) = 4.58, $p < .01$. Means for this interaction appear in Table 2. Duncan multiple comparisons showed significantly (all at least $p < .05$) more time for the cross-fan foil in the small fan condition than in the large fan condition. Also, when learners responded in the small fan condition, they took less time for verifying a true statement than for correctly responding to a cross-fan foil or an outside-story foil.

A separate analysis was performed to determine whether there was a difference in response time for correct responses versus incorrect responses. That is, did learners take longer to make a wrong judgment than a right one? In this analysis, a mean response time for all correct responses and a mean response time for incorrect responses were computed for each learner, across all experimental conditions. The analysis of variance yielded a significant effect, F (1, 18) = 13.62, $p < .01$. This indicated that incorrect responses did, indeed, take longer (mean = 3.76 seconds) than correct responses (mean = 3.25 seconds).

An analysis of variance was corputed to determine if differences between conditions existed for the number of correct responses made by learners. This was a 2 X 2 X 4 mixed analysis with one between-subjects variable and two within-subjects variables. This was similar to the analysis of variance described earlier for response time except that all responses to all items were included. To balance the six

target probes with the two foils in each condition, the target probe total was divided by three prior to this analysis.

This analysis of the number of correct responses yielded three significant effects. A significant main effect for the number of times heard, F (1, 18) = 9.80, $p < .01$, indicated more correct responses when the message was heard three times (mean = 1.70) than when it was heard only once (mean = 1.35). There was a significant two-way interaction for number of times heard by fan size, F (1, 18) = 6.81, $p < .01$. These means are reported in Table 3. Analysis of this interaction by the Duncan Multiple-Range Test indicated no difference between the large fan and small fan when the message was heard one time ($p > .05$); more correct responses occurred, however, for the large fan than the small fan when the message was heard three times ($p < .01$). Further, the large fans showed a significant increase in correct responding when the conversation was heard three times as opposed to once ($p < .01$), but the small fans did not ($p > .05$).

The third significant effect was the two-way interaction for fan size by type of test statement, F (3, 54) = 10.74, $p < .01$. These means may also be found in Table 3. In the large fan, the within-fan foils yielded fewer correct responses than either the outside-story foils or the cross-fan foils. In the small fan, the outside-story foils were more troublesome than within-fan foils, cross-fan foils, or true statements. The large fan produced fewer correct responses than the small fan when the foils were internal, but the large fan involved more

correct responses than the small when the foils were external. All of these differences were at least $p < .05$.

Discussion

It was expected that hearing the conversation between Holmes and Watson three times as opposed to once would facilitate performance. Furstenberg, Sebrechts, and Seamon (1987) found that as associative strengths between a cue and a target increase, both recall and recognition increase. Knowledge assembly theory includes the concept of unitization whereby two or more previously discrete concepts become a single knowledge structure. This phenomenon is a function of additional exposure to the stimulus materials and practic- (Hayes-Roth, 1977; Pirolli & Anderson, 1985). In the present research, learners who heard the conversation three times were more likely to respond correctly and tended to respond more quickly.

The number of times the conversation was heard also had an impact on correct response when viewed in light of the size of the fan. Although there was a trend toward more correct responses in the small fans when the message was heard multiple times, this superior performance reached a significant level only in the large fan. It is plausible that the episodic nature of the passage (scripts) along with the semantic theme yielded a particularly integrated structure for Grimsby Reylott and Miss Helen Stoner (large fans). They were causally linked throughout the passage such that the

propositional network may have represented an integrated pattern of links and nodes (Myers, et al., 1984; Moeser, 1979; Reder & Ross, 1983; Smith, et al., 1978).

Another factor that appears to interact with number of exposures to the stimulus materials is the nature of the test statements. Test statements that accurately represent the facts (target probes) are most quickly identified. This is consistent with previous research (e.g., Reder & Anderson, 1980). Hearing the discussion between Holmes and Watson three times tended to reduce the variance among the types of test statements. Slowest responses were apparent when a target concept from one fan was tested with a predicate from another fan (cross-fan foil). This sort of re-pairing has produced difficulty for learners in experiments where the statements are artificially constructed, and when, for example, the lawyer might as logically be in the bank as in the park (Anderson, 1983a). In linear priming experiments (e.g., Ratcliff & McKoon, 1981), an attempt is made to determine if proportionally more time is taken for activation to spread across a greater number of links (distance) between concepts in the semantic network (Collins & Quillian, 1969). In the cross-fan condition, where the subject and predicate can be thought of as distant from each other, there appeared to be some support for this notion.

The nature of the test statements was related to fan size on both dependent measures. Outside-story foils and cross-fan foils were more troublesome in the small fans than the large

fans in terms of both number of correct responses and response time. From a spreading activation perspective, the node strengths and consequent link strengths may be less for some nodes in a small fan than a large fan. For example, node strengths for Miss Helen Stoner and Grimsby Roylott (target concepts in the large fans) should be greater than for the wife or the old house (target concepts in the small fans) because of increased exposure (Anderson, 1983a; 1983b). Link strength between concepts (nodes) is said to be a function of the node strengths of those concepts. While a larger fan may reduce link strength by virtue of the increased number of links from target concepts, if a theme has been built (episodically or semantically), subnodes may be formed that act in a more unitized way (Moeser, 1979; Myers et al., 1984; Reder & Anderson, 1980; Reder & Ross, 1983). All participants in the experiment undoubtedly had prior knowledge about Holmes and Watson that they could use to help integrate the new information (Anderson, 1981).

The node strengths and consequent link strengths should have been much stronger when the conversation was heard three times. More activation would, thus, be available to spread from both concepts in a target test statement. Faster and more accurate verification of test statements would be expected (Furstenberg, et al., 1987). Foils have no appropriate intersection of the activation spreading from the two concepts in the test statement. When more semantic distance (cross-fan foil) or a more nebulous search space

(outside-story foil) is involved, response time should increase as it did in the present research. Typically, a conversation is heard only once rather than three times. The leveling effect of repeated exposure does not occur in real-world contexts. But it is also true that conversations usually are not packed with as many facts as the one between Sherlock Holmes and Dr. Watson. It will be interesting to determine how well these interpretations hold in more naturalistic communications.

References

Anderson, J.R. (1974). Verbatim and propositional representation of sentences in immediate and long-term memory. Journal of Verbal Learning and Verbal Behavior, 13, 149-162.

Anderson, J.R. (1983a). Retrieval of information from long-term memory. Science, 220, 25-30.

Anderson, J.R. (1983b). The architecture of cognition. Cambridge, MA: Harvard University Press.

Anderson, J.R. (1981). Effects of prior knowledge on memory for new information. Memory and Cognition, 9, 237-246.

Anderson, J.R., & Bower, G.H. (1973). Human associative memory. Washington, DC: Winston & Sons.

Collins, A.M., & Quillian, M.R. (1969). Retrieval time from semantic memory. Journal of Verbal Learning and Verbal Behavior, 8 240-247.

Furstenberg, C.T., Sebrechts, M.M., & Seamon, J.G. (1987). Accessing associative strength in cued recall and pair recognition. American Journal of Psychology, 100, 239-251.

Glucksberg, S., & McCloskey, M.E. (1981). Decisions about ignorance: Knowing that you don't know. Journal of Experimental Psychology: Human Learning and Memory, 7, 311-325.

Hayes-Roth, B. (1977). Evolution of cognitive structures and processes. Psychological Review, 84, 260-278.

King, D.R.W., & Anderson, J.R. (1976). Long-term memory search: An intersecting activation process. Journal of Verbal Learning and Verbal Behavior, 15, 587-605.

Moeser, S.D. (1979). The role of experimental design in investigations of the fan effect. Journal of Experimental Psychology: Human Learning and Memory, 5, 125-134.

Murray Hill Records, Mutual Broadcasting System. (1945). Tales from Baker Street: The adventure of the speckled band. Recording produced from the archives of Radio Yesteryear Records with permission of Stallion Record Corp.

Myers, J.L., O'Brien, E.J., Balota, D.A., & Toyofuku, M.L. (1984). Memory search without interference: The role of integration. Cognitive Psychology, 16, 217-242.

Osgood, C.E. (1949). The similarity paradox in human learning: A resolution. Psychological Review, 56, 132-143.

Peterson, S.B., & Potts, G.R. (1982). Global and specific components of information integration. Journal of Verbal Learning and Verbal Behavior, 21, 403-420.

Pirolli, P.L., & Anderson, J.R. (1985). The role of practice in fact retrieval. Journal of Experimental Psychology: Learning, Memory, and Cognition, 11, 136-153.

Ratcliff, R., McKoon, G. (1981). Does activation really

spread? Psychological Review, 88, 454-462.

Reder, L.M. & Anderson, J.R. (1980). A partial resolution of the paradox of interference: The role of integrating knowledge. Cognitive Psychology, 12, 447-472.

Reder, L.M., & Ross, B.H. (1983). Integrated knowledge in different tasks: The role of retrieval strategy on fan effects. Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 55-72.

Smith, E.E., Adams, N., & Schorr, D. (1978). Fact retrieval and the paradox of interference. Cognitive Psychology, 10, 438-464.

Author Notes

This research was supported, in part, by the National Institute of Disability and Rehabilitation Research through the West Virginia Rehabilitation Research and Training Center (West Virginia University and West Virginia Division of Rehabilitation Services). Appreciation is expressed to Sylvia Konchesky for manuscript preparation. Elizabeth A. McGreal is currently at Castleton State College, Castleton, VT.

A copy of the timing program may be obtained by sending a blank diskette to the address given below. Also, contact the first author for information about the tape of the radio show, "The Adventure of the Speckled Band."

Requests for reprints and information should be sent to Richard T. Walls, Research and Training Center, 806 Allen Hall, West Virginia University, Morgantown, WV 26506-6123.

Table 1

Test Statements (Targets and Foils)

Type of Statement	T or F	Fan Size: Large Small	Statement
Target	T	L	Miss Helen Stoner was befriended two years ago.
Target	T	L	Miss Helen Stoner was engaged to a young soldier.
Target	T	L	Miss Helen Stoner was afraid of her stepfather.
Target	T	L	Dr. Grimsby Roylott was a distinguished surgeon.
Target	T	L	Dr. Grimsby Roylott married a woman with money.
Target	T	L	Dr. Grimsby Roylott is 55 years old.
Within-Fan Foil	F	L	Miss Helen Stoner wrote to Watson.
Within-Fan Foil	F	L	Dr. Grimsby Roylott was once in prison.
Cross-Fan Foil	F	L	Miss Helen Stoner was once in an insane asylum.
Cross-Fan Foil	F	L	Dr. Grimsby Roylott had a sister who died suddenly.
Outside-Story Foil	F	L	Miss Helen Stoner always wore black.
Outside-Story Foil	F	L	Dr. Grimsby Roylott traveled in France.
Target	T	S	The old house was in Stokemoran.
Target	T	S	The wife had money before she married.

Target	T	S	The trust fund would be taken care of until the girls got married.
Target	T	S	The letter was received that morning.
Target	T	S	One of the witnesses was Dr. Watson.
Target	T	S	The scrapbook had information about the Lords and Simon case.
Within-Fan Foil	F	S	The old house was the site of three deaths.
Within-Fan Foil	F	S	The letter said she would call at noon.
Cross-Fan Foil	F	S	The wife was at the coroner's inquest.
Cross-Fan Foil	F	S	One of the witnesses died mysteriously.
Outside-Story Foil	F	S	The trust fund was set up before the girls were born.
Outside-Story Foil	F	S	The scrapbook was on Watson's desk.

Table 2

Mean Seconds for Conditions in Significant Two-Way Interactions

Number of Times Heard	Type of Test Statement			
	Target Statements (True)	Within-Fan Foils (False)	Outside-Story Foils (False)	Cross-Fan Foils (False)
One	2.94	2.90	3.29	3.95
Three	2.64	3.31	3.09	2.95
Fan Size				
Small	2.56	3.21	3.64	4.04
Large	3.03	3.04	2.91	2.95

Table 3

Mean Correct Responses (of 2.0 Possible) for Conditions in Significant Two-Way Interactions

Number of Times Heard	Fan Size Small	Large
One	1.40	1.30
Three	1.52	1.88
Type of Test Statement		
Target Statements (True)	1.75	1.60
Within-Fan Foils (False)	1.70	1.30
Outside-Story Foils (False)	0.95	1.70
Cross-Fan Foils (False)	1.45	1.75

Appendix A

Excerpt from The Speckled Band

Holmes: At the moment, suppose you tell me what you know of Miss Helen Stoner. I received a letter from her this morning in which she informed me that she would be calling here at 11 and also that she was a friend of yours.

Watson: Ehh, Miss Helen Stoner, yes indeed, a charming girl.

Holmes: Then pour me a cup of tea, Watson, and tell me about her.

Watson: Well, I befriended her at the time of the tragic death of her sister, two years ago. I told you about the case, don't you remember -- the sudden death of Violet Stoner at an old house in Stokemoran.

Holmes: Oh yes, yes, yes. It all comes back to me now. There was an inquest, wasn't there . . .

Watson: Yes indeed.

Holmes: . . . with a string of stupid and ineffective witnesses.

Watson: They weren't stupid. I was one of them.

Holmes: Oh, I beg your pardon, Watson. Then you were the exception, of course. Oh wait a minute, wait a minute, let me see. I documented the evidence on the case. Where was it? In my scrapbook. Oh yes, here we are. Here we are. Let's see. Yes, yes. Salisbury hatchet murder, Lords and Simon. Ah, here we are, Stokemoran. Oh yes, yes, of course. I remember the affair quite well now. The villain of the piece was Dr. Grimsby

Roylott, wasn't it?

Watson: Yes, dreadful fellow. He's the stepfather of the two girls. Violet, the one who died so mysteriously, and Helen, the one who is coming here to see you.

Holmes: Dr. Roylott has a pretty record. Fifty-five years of age, killed his [unintelligible] in India, once in an insane asylum, married money, wife died, distinguished surgeon. Well, I wonder what the distinguished surgeon has been up to now.

Watson: Some deviltry, I fear.

Holmes: Oh? Why do you say that?

Watson: You remember that Miss Violet Stoner's death followed close upon the announcement of her engagement?

Holmes: Yes, I do.

Watson: Well, I met Miss Helen Stoner in the streets a few weeks ago. She told me that she had just become engaged herself to a young fellow in the army who is leaving for the far east. I am certain. The thought of being alone with her stepfather at Stokemoran.

Holmes: Well, that's quite natural. You see, Dr. Roylott stands to loose a considerable sum of money in the event of his stepdaughter's marriage.

Watson: Yes, a trust fund which he administered only as long as the girls weren't married. That fact was brought out at the coroner's inquest two years ago. But if Roylott did poison the other stepdaughter, and I'm convinced that he did, it seems unlikely that he would try it again. Two

sudden deaths in the same household would hardly pass the coroner.

Holmes: Oh, my dear Watson. You're making the mistake of putting your normal brain into Roylott's abnormal being.